Committee on Earth Observation Satellites
17th Plenary Meeting
Colorado Springs, Colorado
November 19-20, 2003

CEOS/17/Utilization

Item 5.1

Utilization Team Report and Recommendations

SUMMARY AND PURPOSE

This report presents the work of the ad hoc Utilization Team that was convened at the request of CEOS Chair Greg Withee and led by John Townshend.

ACTION PROPOSED

The meeting is invited to take note of the information contained in this document, and take appropriate measures to implement the recommendations outlined in Section 5 below.

Report of the CEOS ad hoc Team on Utilisation.

Prepared for the 17th. CEOS Plenary 18th. – 20th. November 2003, Colorado Springs, USA at the request of the CEOS Chairman.

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29 October 2003

Final Report of the CEOS ad hoc Team on Utilisation.

1. 1. Introduction

1.1. Rationale and Background

At the 16th CEOS Plenary in Frascati in November, 2002, Mr Greg Withee, Chairman of CEOS, announced that during his term of office he would give priority to encouraging and facilitating the increased use of space date, products and services. To this end he appointed a small ad hoc team charged with developing recommendations for consideration at the 17th CEOS Plenary in November, 2003.

In subsequent discussions with the Chairman, it was agreed that the Team would consult widely among the user communities and that the results of these enquiries might later be published as an information and reference document separate from the report for CEOS Members and Associates. The Chairman of CEOS has also arranged for a brochure to be published after the 17th CEOS Plenary to publicise the recommendations as approved by plenary, and to give examples of case studies used by the team during its work.

1.2. Team Membership

The team was chaired, at the request of the CEOS Chairman, by Prof. John Townshend (University of Maryland). Members were:

> Dr Stephen Briggs (ESA), Mr Yukio Haruyama (JAXA), Dr Paul Menzel (NOAA), Prof Liangming Liu (NRSCC), Dr Gilles Sommeria (WCRP), Dr Jeff Tschirley/Dr John Latham (FAO), with Dr Brent Smith (NOAA) acting as the link with the CEOS Chairman. The rapporteur was Mr Roy Gibson (EUMETSAT).

In addition Dr David Williams (EUMETSAT), Mr Chu Ishida and Mr Stephen Ward (JAXA), Prof Li Deren and Dr Li Mengxue (representing NRSCC), Mr Guy Duchossois and Mr Michael Hales (NOAA) participated in some meetings and telephone conferences.

Ms Judy Carrodeguas provided invaluable secretarial support.

1.3. Purpose and structure of final report

The report is intended to present the Team's findings and recommendations to Plenary, and to explain how the team interpreted and carried out its mandate. Since the subject is clearly one of continuing interest to Plenary, some suggestions are also made for future action, so that it will continue to receive the attention it deserves.

Section 2 describes how the Team undertook its work, including the assembling of case studies, where data, services or products are known to have been used in operational or semi-operational systems. The lessons derived from these case studies form an important part of the Team's recommendations. Section 2 also includes the results of interviews, which team members conducted with a number of experienced users of satellite data in different regions.

Section 3 identifies the reasons, which either facilitate or hamper the increased use of satellite data, products and services, and structures them in a number of different categories.

Section 4 lists the principles, which have been distilled from the case studies, interviews and the Team's own discussions. These principles are believed to have fairly general applicability.

Section 5 contains the Team's recommendations which are addressed not only to CEOS as a body, and to its working groups, but also to individual members and associates.

2. Modus operandi of the Team

It is basic to this study that increased utilisation of space-derived data, products and services is a good thing in its own right. There is certainly no lack of evidence of the benefits it can bring. While all space agencies undoubtedly wish to see the widest use of data acquired by the satellite systems for which they are responsible, it should be recognised, that some agencies do not have a specific remit to be proactive in promoting the use of their data for classes of users outside those for whom the satellite project was intended, nor do they necessarily have a mandate to undertake the regular re-processing necessary to ensure continuity.

The main emphasis of the study has been on situations where the desired outcome is a sustained capability rather than increasing the number of one-off users. The Team of course looked both at making more use of existing data, as well as increasing the use of future satellite missions. The Team considered both those situations where immediate increases in utilisation are realisable as well as those where some sustained collaboration between space agencies and users may be needed (likely with some resources from space agencies) before operational applications can be developed.

Discussions of potential users often imply that there are many more waiting to be found. This is not the case for all types of users: some markets may already be close to saturation. For example, although weather forecasting centres may need improved observations, the number of such centres is unlikely to grow. Hence there may be situations where there may only be the prospect of an improved use of remote sensing, without any actual increase in the number of users.

It is worth noting that, compared with even 10 years ago, the costs of many elements of information systems are much lower, including costs of local ground receiving stations and computer hardware and software. These all combine to make it less expensive to integrate remote sensing products into information systems, and hence potentially increasing the number of users.

The team met 3 times during the period April-October 2003, and a good deal of the work was conducted by e-mail. The first meeting in Silver Spring, Maryland on 23rd/24th April 2003 , was hosted by NOAA, and was used to brief Team members, including a teleconference to link those unable to be physically present. The Chairman provided a template to facilitate a uniform presentation of case studies, and later issued a note on the conduct of interviews aimed at encouraging a frank recording of the views of those interviewed. The second meeting was held on 3rd/4th June in Paris, hosted by ESA. The third meeting was held in Frascati hosted by ESRIN/ESA on 18th /19th September, 2003.

Appendix A gives a list of the 25 case studies compiled by the team, and Appendix B lists those who have been interviewed, or have in one way or another contributed to the study. The Chairman and his colleagues take this opportunity to thank all who have devoted time to helping the Team's work.

3. What factors affects adoption of remote sensing

3.1. Analysis of case studies

Examination of the successful case studies indicates that more of the factors favouring adoption of remote sensing products by users are within the province of the users themselves, rather than with the space agencies, but it needs to be stressed that successful adoption always involves balanced cooperation between space agencies and users. In this co-operation space agencies can and should do more to ensure the greater uptake of their data and services.

Critical from the space agency point of view is a) provision of user-specific products; b) making resources available speedily and with a minimum of bureaucracy; c) willingness to listen over an extended period to user needs and practical difficulties and d) to accommodate them to the maximum extent practicable – going so far sometimes as to incorporate user representatives into a joint project team

Added to these factors, several case studies stressed the importance of keeping user development projects simple, and building further on reliable, successful initial projects. However, there is evidence to suggest that turning prototypes into sustained operations is frequently unsuccessful if the funding from users does not continue beyond the prototype phase. Space agencies therefore need at a relatively early stage to seek assurance that the user has sufficient interest and capacity to continue the project beyond the prototype stage.

From the user standpoint, success appears to be very dependent on a) the user having an understanding, and preferably first hand-experience, of the use of remote sensing data and products, and their integration into geospatial information systems, b) a willingness to make appropriate staff available before and during the project to work with the space agency; c) the user having a core need, such as a statutory need, for the information and an ability to define rather precisely what the needs are; d) the user being willing and able to help develop a realistic financial scenario for an operational system.

On both sides, the case studies indicate the need for innovation and flexibility in response to new opportunities for data products. Equally important is the role that individuals can play. Sometimes, these are senior champions in either space agencies or less frequently in user organisations. In other cases it may be an individual facilitator with considerable experience in new remote sensing technology, algorithms and user communities, and who can take the necessary short cuts to cause new uses rapidly to occur.

The development of partnerships between users, space agencies and research organizations such as universities often figured prominently. In several case studies industry also played a significant role in increasing utilisation.

3.2. Technical factors encouraging the adoption of remote sensing

Analysis of case studies showed that the principal obstacles faced, and to varying extents overcome, were overwhelmingly technical and fell into the following categories:

- need to provide adequate bandwidth for data access;
- devising adequate distribution networks;
- need to provide new or improved algorithms;
- development of faster data processing techniques (e.g., calibration techniques for SAR images);
- need to improve the basic classification systems to which the remote sensing project is designed to contribute and
- need to demonstrate that continuity of space observations can be assured.

However the importance of technical obstacles might be smaller had the study considered more unsuccessful case studies.

Where major improvements in observational capabilities occur there is often immediate potential for improved use. For example the availability of moderate resolution MODIS data with its much higher capabilities compared with the AVHRR has led to a number of rapid improvements in capabilities. For example the use of MODIS data to assist fire-fighting in the United States or the use of MODIS polar winds in ECMWF assimilations may be mentioned. Adoption of MODIS is encouraged by the planned follow-on of the VIIRS sensor of NPP and NPOESS, with its similar capabilities to MODIS.

Not only may such new capabilities offer the possibility of enhancing systems already using remote sensing, they may also offer the possibility of significant new uses of the data. One notable example of a space agency positioning itself in this way is Eumetsat with its seven Satellite Application Facilities (SAFs) set up to exploit the increased capabilities of Meteosat Second Generation for non-weather and climate applications. They offer a potentially valuable model for other agencies concerned with increased exploitation of new observational capabilities. Enhancement in observational capabilities can also arise from improved acquisition strategies. The use of Landsat data increased substantially with the introduction of a much improved acquisition strategy greatly increasing coverage; increased use also stemmed from a sharp reduction in costs.

Where major changes in observational capabilities are known to be occurring in the foreseeable future it is normally incumbent on the responsible agencies to ensure that users are aware of these. They may also consider the desirability of providing appropriate training and contributing to capacity building especially where existing operational users are likely to benefit from these improvements.

3.3. Education and capacity building encouraging the adoption of remote sensing

Lack of trained staff and modern hardware and software were, not surprisingly, also encountered. Remote sensing can in some respects be regarded as a relatively mature technology and, as a result, in some sectors many potential users are well aware of its ability to meet their needs. However, this does not always apply in developing countries, and even users in the developed word may need additional training (as well as updated hardware and software) if they are to make best use of new data sets, which often have much higher data-rates. Education and capacity building are clearly of growing importance, and there will be increased requests to make data for this purpose more accessible.

It is suggested that, from the point of view of increasing utilisation, the best formula is for education and capacity building to be arranged in conjunction with a practical project, rather than in the round. It is essential for each project at an early stage to realistically assess the amount of education and training which will be needed in order to ensure that the project will successfully develop into an operational capacity. The understandable tendency to underestimate the cost of this element will certainly militate against success. The Team noted with interest an initiative to address training to teacher groups, rather than to student users.

3.4. Financial factors affecting the adoption of remote sensing

There is no substitute for the user being willing to spend his own time and resources to define and develop a project. Alongside space agencies and new users, third parties can also play an important role. This may be in a funding role, as in the case of the European Commission in Europe or the World Bank. Such financers rightly insist on the project being designed realistically and economically to meet user needs. In Europe, private companies may also play a major role in developing user capabilities and in linking users with space agencies.

3.5. Policy factors affecting the adoption of remote sensing

Two other obstacles, of a somewhat different nature, are apparent: restrictions on data access because of local data policies, and the regular complaint of the high cost of satellite data and products. It is beyond the remit of the Team to deal in depth with these two factors, but it would be unrealistic not to identify them. Perhaps the most that can be said is that space agencies should be encouraged to release data expeditiously and at the lowest cost, whenever they are needed in connection with an approved project or for a use consistent with the work which CEOS is promoting with WSSD and with the Climate Conventions.

4. Principles to encourage the adoption of remote sensing

4.1. Introduction

Based on the previous considerations we can identify three main ways in which the use of remote sensing can be enhanced.

First there are those situations where users already have information or forecast systems using remotely sensed data. Improved observations become available and these are introduced to the existing operational system. Even in these circumstances increasing utilization, may not be a trivial exercise and usually requires active cooperation between user and space agencies.

Second there are situations where users have not normally used remote sensing. This will usually require a significant effort for the needed skills and facilities to be transferred. Many of the case studies include examples of this sort.

Yet a third possibility exists where space agencies or contracted intermediaries are made responsible for base-lined standard products, with well-characterized properties in terms of Cal/Val and QA/QC. In these situations many users could adopt products without the need greatly to add to their technical knowledge and facilities to a major extent.

4.2. Assurance of continuity

For users to adopt remote sensing there is a need for systems to have ensured continuity. Security of data and product supply is essential and operational users have to receive firm assurances to be sure that there will be long-term continuity. Operational agencies need to be assured that the significant initial costs incurred in changes in their business practices to accommodate the use of satellite data will be recovered through guaranteed long term access to satellite data.

4.3. Need for adequate information systems and spatial data infrastructure

In many parts of the world successful information systems may exist and the benefits of remote sensing may appear marginal compared with existing in situ sampling schemes. But in other parts of the world adequate environmental information systems often do not exist, especially in the developing world. Where aid is provided it is vital that there is not merely investment in receiving station capability (in some cases there are too many receiving stations which seem to be regarded as status symbols), but also in end-to-end capabilities from acquisition to product generation and use. Although there may be considerable potential for application of remote sensing, sustaining such capabilities in the poorest countries of the world may be difficult without long-term aid.

4.4. Space agencies responsibilities for information systems

Although in some cases it is not expressly within their mandates, space agencies have key long term stewardship responsibilities in ensuring data delivery, data archiving and reprocessing for climate-quality data sets. Users have to be sure that these will be executed regularly and to the highest possible standards

4.5. Enhancing data delivery systems

In some situations data systems may be designed for scientific researchers and be inadequate for other applications. For example delivery of data for scientific uses may be days or weeks after acquisition. Providing a capability to access and process data almost instantaneously significantly increases the range of possible applications. This helps explain the increasing popularity of local ground receiving stations. A notable example of this is ATOVS where direct broadcast has been maintained and a preprocessing package was created and distributed with international collaboration.

4.6. Ensuring that consistent long term data sets are created

Many uses of remotely sensed data rely on internally consistent long term data sets especially in relation to understanding climate change and assessing its impacts on socio-economic activities. From time to time major new uses of environmental records may arise and it would be prudent for space agencies to be prepared to respond to these. Creation of such data sets usually requires very substantive efforts normally involving a considerable amount of reprocessing and analysis.

4.7. Access to integrated assets of multiple agencies

There is a need for users to be able to use the integrated assets of multiple agencies; essential to ensure increased usage. This will often involve the merging and integration of data sets by data fusion. There is a key role for universities and research efforts outside of space agencies. We recognize that individual space agencies have to promote their own EO assets, and there is a continuing need for such promotion to be realistic in terms of capabilities. There is a need for independent mechanisms to promote integration and to carry out independent assessments of capabilities.

4.8. Crucial role of research in stimulating innovative uses of remote sensing

It is important to highlight the importance of research in general. Examples of areas where significant recent strides have been made include the development of SAR Interferometry and research in NWP. Development of applications often arises on the basis of research. Also there is a need to recognize the importance of integrated research activities between the industrial and research communities. The key roles of research institutions must be recognized in addition to the roles of space agencies and users.

4.9. Improved cooperation between space agencies

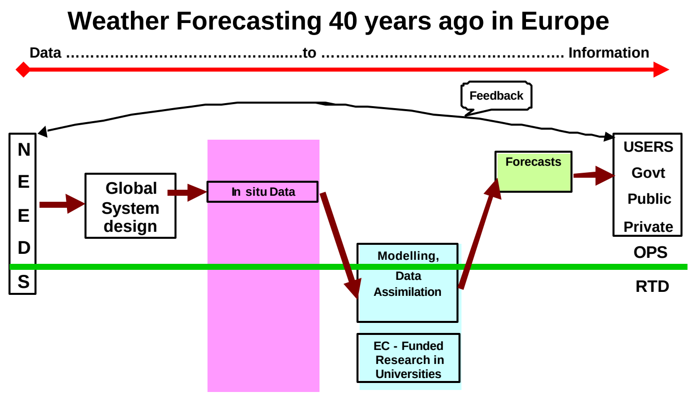
There is a need for mechanisms to avoid potentially unhelpful duplication between space agencies. The proposals for a more integrated approach between NASA's Pathfinder and ESA's Explorer program are to be welcomed. Cooperation will needed as early as possible, including the definition and selection phases. The optimal situation in terms of international cooperation may often be where users pose key needs which receive a coordinated response. A notable example of this is JASON-2. Where there are international jointly funded programs such as GPM or other missions with multiple international components, consideration should be given to joint science teams for the above activities.

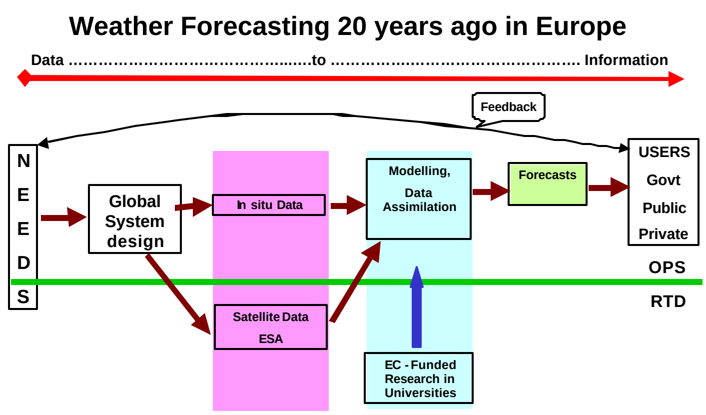
4.10. Sustained capacity building

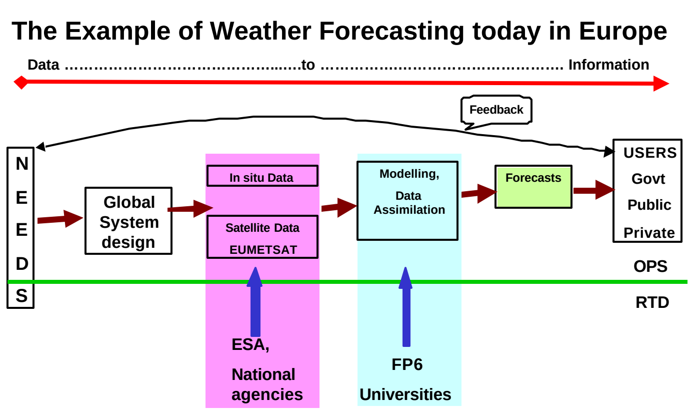
With improvements in observational capabilities there will be a continuing need for capacity building in developing and developed and countries. Such outreach needs to be embedded within continuing projects to secure the long term benefits available from increased capability. This must be supported by a continuing stream of high quality technical and educational publications and outreach to users.

4.11. Need for strategies to cope with the long time periods between problem identification and the arrival of an operational system

Strategies are needed to deal with very long times between problem identification and provision of comprehensive observational solutions. The timescale of response to the relatively simple problem of global stratospheric ozone, ideally suited to remote sensing techniques, is indicative of the long time constants inherent in addressing such problems. The long time period needed to introduce the use of operational remote sensing satellites for weather forecasting in Europe is illustrated in the accompanying figure.







The evolution of the utilization of remotely sensed data in European weather forecasting (Source: D. Williams, Eumetsat).

4.12. Recognition of new partners and the distinctive needs of new users

During the last few years major new types of users are beginning to adopt remote sensing. These include NGOs who require observations for purposes such as conservation and humanitarian relief. Others include media organizations requiring very timely information. Space agencies will need to recognize and adapt to their special needs if adoption is going to be successfully achieved by these new sets of users. In developing partnerships with the private sector this should not automatically be interpreted as meaning the aerospace industry, but new partners, such as insurance companies, already providing services on a large scale through non-space means.

4.13. Political ownership of benefits

There is a need to promote uses that have a high political impact. The benefits for political leaders have to be included since political ownership of the benefits of remote sensing will encourage investment in the adoption of remote sensing. It is also important that legislators are kept aware of major advances in capabilities, which could influence the introduction of legislation e.g. reliable monitoring of tropospheric ozone could conceivably lead to the introduction of legislation based on this capability.

5. Recommendations

The preceding sections contain information and "tips" which the Team hopes will be of interest and use to at least some readers, but it was decided to concentrate here on a few major recommendations, rather than to convert the earlier text into a long series of mini-recommendations.

1. Real-time access to data streams is leading to increasing use of remotely sensed data, especially where preprocessing packages are made available to users. The latter means that the initial responsibility to ensure the processing and delivering of products rests with the agency rather than the user. It is important that agencies make pre-processing packages available to the greatest extent possible, whether they are developed in-house or in the research or commercial communities. Real-time access includes but is not limited to direct broadcast. **It is recommended that CEOS space agency members consider (a) making data streams available in real time whenever possible , and (b) provide any necessary preprocessing software, a benchmark data set and a focal point for questions.**[1]

2. The quality of information about instruments made available by space agencies varies considerably. **Space agencies are urged to reevaluate the way in which they provide information about past, current and future systems including the provision of high quality up-to-date information concerning instrument performance especially calibration and product quality assessments. In this regard the maximum use should be made of the CEOS/WMO data base.**

The CAL/VAL Working Group should be instructed to study how a much more standardized approach could be adopted by CEOS space agency members to improve users' understanding of sensors and their resultant data sets, and to report on their findings to CEOS Plenary 2004.

3. Best use of remotely sensed data increasingly depends on use of data from multiple sensors often from multiple agencies, but this is often significantly hindered by the lack of coordination between information systems. **CEOS space agency members need to develop**

[1] China proposes to host a workshop next year on rapid response systems for terrestrial and coastal applications. This will represent an important step in fulfilling this recommendation, and CEOS members with an interest in this field are strongly advised to participate.

information systems with more integrated catalog, search, ordering and retrieval mechanisms. It is recommended that the WGISS Working Group study how best to develop this incrementally for particular application fields building on experience gained in developing such capabilities with CEOP and to report on their findings to CEOS Plenary 2004.

4. Increasing the utilization of remotely sensed data is dependent on developing improved partnerships with users. This is, of course, very much a matter for individual agencies, and much has already been done. Nevertheless, **it is recommended that CEOS space agency members commit to seeking ways of increasing and improving partnerships, including those with NGOs and universities.** These could include the following but need not be limited to them:

- Improve the representation of scientific and other users on their advisory bodies.
- Work more intensively with the scientific community to develop new applications and services and specifically work to develop improved assimilation procedures.
- Consider the possibility of selectively improving the funding of new research and other application activities.
- Consider coordination between agencies in providing funding for research and other applications.
- Where there are internationally coordinated remote sensing activities such as GPM, then consider setting up international science panels in conjunction with appropriate international research organizations.
- Establish closer links with the scientific and political arms of the international environmental conventions and agreements.
- Strengthen links with policy makers and international conventions for high profile data utilization in keeping with the high priority given to this by CEOS.

Reflecting the strong emphasis of CEOS agencies on planning Earth observation missions for the purpose of climate and global environment studies, particular attention should be placed on improving the dialogue with relevant user communities for the planning, specification, and application of these missions. This should include establishing closer links with the scientific and political arms of the climate conventions (e.g., the UNFCCC and its SBSTA) and should take account of high priority information needs as defined by bodies such as the IPCC.

5. Use of remotely sensed data is sometimes restricted by the fact that although products have been demonstrated in a research environment and have been produced at a regional level their value at a global level has not been demonstrated and recognized by the users. Examples include global albedo, fire products and other high priority ones identified in the IGOS themes as having critical deficiencies. **It is recommended that CEOS space agency members provide mechanisms to allow the creation of these and other key global data sets[2].** One possible mechanism could be for multiple agencies to make their data available and then for one (or maybe 2) agencies to produce them globally using different software. Inter-comparisons and validation of the results would be carried out in close coordination with representative user groups.

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[2] It is recommended that the forthcoming GOFC-GOLD/CEOS-CVWG-LPV workshop on global fire and albedo products to be hosted at Eumetsat in March 2004 should be invited to initiate and scope this process with the assistance of EUMETSAT and other volunteer agencies.

6. A restrictive data policy can often significantly limit access to data and products and hence inhibit utilization. Commercial considerations and the need to prioritize the allocation of limited ground segment resources, for example the planning, acquisition and delivery of high resolution data sets are legitimate reasons for restricting access to data, but, these apart, **CEOS agencies are invited to agree to make data easily and cheaply available, especially when it is in response to a specific request consistent with CEOS efforts to promote sustainable development in its widest sense.**

7. Capacity building, education and training remain high priorities in developing and developed countries and will remain a significant responsibility of space agencies. Experience from the case studies shows that these are often most effective in transferring capacity to local users, when performed within the context of specific projects, when the support of key decision makers is included and when working in partnership from the very beginning with the end users. **It is recommended that wherever possible capacity building be integrated within specific projects and in particular in ones where sustained funding will be available following the success of the prototype phase. The ad hoc Working Group on Education and Training should be asked to take account of this recommendation in its work and report on its response to CEOS Plenary 2004.**

8. Interviews confirmed that creating long term consistent records of the environment is of the highest importance for many key users of remotely sensed data: it is also extremely challenging for agencies responsible for their creation. As one step in this direction**, it is recommended therefore that CEOS members make best efforts to adopt the GCOS Climate Monitoring Principles[3].**

9. Increasing the utilization of satellite data cannot be achieved by the implementation of a single report, and **it is recommended that the Chairman of CEOS:**

- **ensures that the subject is included on the agenda of future Plenaries;**
- **gives instructions to the three Working Groups to give priority to assisting in the implementation of the Team's recommendations over the coming years; and**
- **proposes to continues the subject as a priority theme for the coming year.**

[3] For the current set of principles refer to GCOS (2003) **Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC**, Appendix 2, p. 57 GCOS-82; WMO TD 1143. http://www.wmo.ch/web/gcos/gcoshome.html. Note the recommendations (11-20) relating specifically to satellite observations.

6. Appendix A List of case studies

	Name of case study	Interviewees[1]	Compiled by:
1	MODIS Fire Rapid Response System	Rob Sohlberg, Chris Justice	John Townshend
2	Application of the HY-1 satellite for sea ice monitoring and forecasting (The sea ice retrieval System)	Ting Liu	Deren Li
3	Meteorological Satellite Fire Monitoring System	Lujun Guo	Deren Li
4	Integrated operational system of flood monitoring and assessment	Shifeng Huang	Deren Li
5	Monitoring system of ice conditions for the Yellow River	Haolu Ma	Deren Li
6	Crop monitoring system using remote sensing	Guoping Liu	Deren Li
7	The application of CBERS-1 data in forest resources investigation	Wei Cai	Deren Li
8	Application of satellite remote sensing to fishing industry	Hideo Tameishi	Yukio Haruyama
9	Collaborative research on sea ice observation by Earth Observation data.	Hiromi Nakamura	Yukio Haruyama
10	Collaborative research on development of land utilization distribution by Earth Observation satellite data.	Masahiro Baba	Yukio Haruyama
11	MODIS polar winds		Paul Menzel
12	Sounder data utilization		Paul Menzel
13	Assimilation of satellite data in NWP	Adrian Simmons	Paul Menzel
14	Regional Burned Forest Mapping	Agostino Miozzo	Stephen Briggs
15	Kyoto Inventory		Stephen Briggs
16	Urban Expansion and monitoring (URBEX)		Stephen Briggs
17	Oil Spill Monitoring Center	P E Skrovseth	David Williams
18	Ecosystem (Environmental) Monitoring	Tony Janetos	John Townshend
19	Ozone Alert		Stephen Briggs
20	Virtual Laboratory	J Purdom	Paul Menzel
21	Surface Albedo	Yves Govaerts/Bernard Pinty	David Williams
22	International charter on space and major disasters	Multiple civil protection agencies	Stephen Briggs
23	AMSU Data Utilization		Paul Menzel
24	Sea Level and Ocean Circulation Real Time Monitoring		Gilles Sommeria
25	Ground Monitoring for Civil Engineering Applications		Philip Bally
26	EnviroCast ™ (Remote sensing products for the media)	Dave Jones	John Townshend

1 Note in several cases the template was completed without a formal interview being necessary.

7. Appendix B Contributors to study

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Spot Image

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World Climate Research Program, Climate Variability and Predictability (CLIVAR)

Wei Cai
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Howard Cattle
World Climate Research Program, Climate Variability and Predictability (CLIVAR)

John Eyre
Met Office, United Kingdom

Yves Govaerts
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Shifeng Huang
IWHR, China

Gregg Jacobs
Naval Research Laboratory (NRL)

Tony Janetos
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Chris Justice
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K.R.S. Murthi
Indian Space Research Organization (ISRO)

Jeffy Key
NOAA, National Environmental Satellite, Data and Information Services (NESDIS)

Dieter Klaes
European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)

Pierre Yves Le Traon
Space Oceanography Division, CLS

Fing Liu
NOSAC

Guoping Liu
Institute of Remote Sensing Applications, China

Haolu Ma
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Agostino Miozzo
Department of Civil Protection, Italy

Hiromi Nakamura
Hydrographic and Oceanographic Department, Japan Coast Guard

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John Trinder, Ray Harris and other Committee Chairmen
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